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The Natural Language Sourcebook (Read, Dyer, Baker, Mutch, Butler, Quilici, & Reeves, 1990), a database of processing problems an intelligent computer system might have with natural language, was developed as part of the Artificial Intelligence Measurement System (AIMS). One important use of the Sourcebook is as a means for evaluating intelligent computer systems with regard to their ability to handle specific processing problems. This paper provides an empirical verification of the problem coverage in the Natural Language Sourcebook by referencing output from one intelligent computer system, IRUS (Bates, Stallard, & Moser, 1985), to the Sourcebook exemplars.

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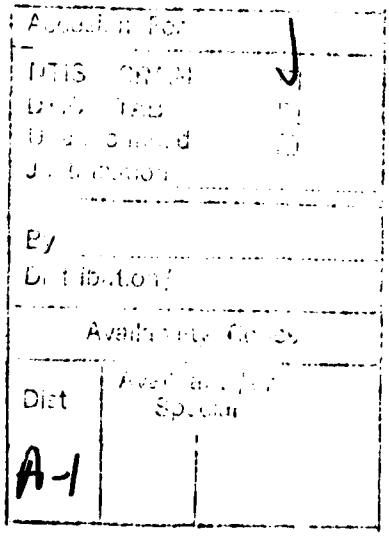

Project Report #11

PROCESSING PROBLEMS IN THE IRUS QUERIES: AN EMPIRICAL VERIFICATION OF PROBLEM COVERAGE IN THE NATURAL LANGUAGE SOURCEBOOK

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Introduction

As part of a larger effort to develop a methodology for evaluating intelligent computer systems, the Natural Language Sourcebook (Read et al., 1990) was produced at UCLA's Center for Technology Assessment. The Sourcebook is a compilation of processing problems that intelligent computer systems encounter when faced with natural language input. The problems, culled from the literature in artificial intelligence (AI), computational linguistics, and cognitive science, provide a representative sample of current processing issues. The entries in the Sourcebook are called "exemplars." Each exemplar includes an example of the processing problem covered, the reference to the literature source which identified the problem, and a discussion of the processing problem from an AI system perspective.

One important use of the Sourcebook is as a means for evaluating intelligent computer systems with regard to their ability to handle specific processing problems. This document provides an empirical verification of the problem coverage in the Natural Language Sourcebook by referencing output from one intelligent computer system to the Sourcebook exemplars. The data source for the verification is a set of 163 queries (questions and commands) from a military application (August 1986 CINCPACFLT demonstration) of a syntactic shell interface, IRUS, which allows a user access to a database through English (Bates, Stallard, and Moser, 1985). The set of IRUS queries is provided in Appendix A.

The IRUS queries present processing problems that span the four major categories of the Natural Language Sourcebook: single-utterance issues, connected-utterance issues, true-dialogue issues, and ill-formed input. Of these four major categories, the category of single-utterance issues is most comprehensively represented. This concentration of processing problems in the area of single-utterance issues is a result of the nature of the IRUS natural language system. Because IRUS is a query system

which allows a user to access a database by means of single-utterance English queries, single-utterance issues predominate. However, connected-utterance and true-dialogue issues arise when several queries in sequence are considered as a group.

This paper considers the IRUS queries in relation to relevant Sourcebook exemplars. The discussion of processing problems in the queries follows the organization and sequencing of the Sourcebook. Each discussion focuses on a single query even when there may be several or many queries that present the same processing problem. In cases where the processing problem under consideration arises in multiple queries, the query chosen for discussion is representative of the larger group of queries. A list of queries organized into groups by processing problem appears in Appendix B. In each group, the query or queries discussed in the text are listed first.

The queries are considered as single utterances (Sourcebook category I), as pairs of utterances presenting connected-utterance processing problems (Sourcebook category II), as utterances in a true-dialogue context (Sourcebook category III), and finally as ill-formed input (Sourcebook category IV).

Natural Language Sourcebook I.

Single-utterance issues are defined in the Sourcebook as issues involving input which the system can understand using only existing, stored knowledge. This knowledge specifically excludes knowing the results of processing previous input. A typical single-utterance problem involves parsing an input in isolation from other inputs.

We will begin by discussing IRUS queries that present processing problems included in the Sourcebook division I.A.: Single-Utterance Issues, the Identification of Syntactic Units.

Natural Language Sourcebook I.A.: Single-Utterance Issues, Identification of Syntactic Units.

Query 40: What deployed ships are harpoon capable

Left to right processing of Query 40 yields two potential parses of the initial three words "what deployed ships": Wh Adj N and Wh V N. Query 40 is similar to the example "The tough coach the young" in Exemplar I.A. (#1). "The tough coach" in isolation can be parsed as either Det Adj N or as Det N V. Exemplar I. A. (#1) discusses this issue of determining the lexical categories of words. In Exemplar I.A. (#1) and in Query 40, this problem could also be described as the problem of recognizing noun groups: "what deployed ships" vs. "what," and "the tough coach" vs. "the tough."

Query 77: What is the personnel resource rating on Vinson

Query 77 presents several processing problems. As in Query 40, the identification of syntactic units as presented in Exemplar I.A. (#1) is relevant: "the personnel resource rating" can be parsed as either Det Adj N V or as Det NModifiers N.

The notation "NModifiers" to represent the words "personnel" and "resource" in this latter parse subsumes two syntactically possible modification structures. The two possible expanded structures for this parse are:

[Det [[Adj [N]] N]] and

[Det [Adj [Adj [N]]]].

Exemplar I.A. (#2) gives examples of both of the above modification structures and discusses principles to help determine the attachment of modifiers to nouns. One principle involves utilizing semantic information about the words involved. But in Query 77, everyday semantic information about the words "personnel" and "resource" is not sufficient to decide between the

two syntactically possible modification structures. The text understanding system must have access to additional semantic information: real-world knowledge specific to the military context. The use of real-world knowledge in determining syntactic structure is discussed in Exemplar I.A. (#7).

Unlike Query 40, Query 77 remains ambiguous when the whole is read: "rating" can remain either a verb or a noun. When "rating" functions as a verb, "what" is the object of the verb "is rating." When "rating" functions as a noun, "what" is the complement of the copula "is." Ambiguity resulting from multiple parts of speech of a word (and the contingent structural ambiguity) is discussed in Exemplar I.B.1. (#22) in regard to the sentence "I saw that gasoline can explode" and in Exemplar I.A. (#1) in regard to the sentence "The tough coach married people." But the ambiguity of Query 77 is specific to the present participle form of a verb and question formation involving the present participle. Query 77 and similar queries (see Appendix B) suggest an exemplar which would specifically address ambiguity involving the present participle.

Exemplar I.A. (#3), which discusses the identification of the head noun for alternate parse trees, is also relevant to Query 77 except that the ambiguity of Query 77 means that the head noun of the noun phrase "the personnel. . ." remains ambiguous as well: the head noun is "resource" if "rating" is parsed as a verb, and it is "rating" if "rating" is parsed as a noun.

Query 18: What ships deployed to the IO are C4

In addition to discussing the determination of the head noun, Exemplar I.A. (#3) discusses the importance of collecting potential parse trees. This aspect of Exemplar I.A. (#3) is relevant to Query 18. In left to right sequential processing, "deployed" can function as either a main verb or as a past participial adjective. Until the word "are" is read, it is not clear how "deployed" is functioning. In either case, the head noun in Query 18 is "ships," so the different parse trees do not

correspond to different head nouns, as they do in Exemplar I.A. (#3).

Natural Language Sourcebook I.B.1.: Single-Utterance Issues, Lexical Ambiguity.

Query 32: How many subs in IO have SAR capability

Query 32 and many others (see appendix) make use of the word "have." "Have" is potentially polysemous, as discussed in Exemplar I.B.1. (#2), but is used with a single meaning in the IRUS queries: to hold or maintain as a possession (e.g., harpoon) or characteristic (e.g., INT readiness of M4). Although only one meaning of "have" arises in the IRUS queries, Exemplar I.B.1. (#2) is, nonetheless, relevant in that a text understanding system should be prepared to handle more than a single meaning of the many common meanings of a highly polysemous word like "have."

Query 124: Total the C3 submarines

The word "total" in Query 124 is ambiguous. Exemplar I.B.1. (#19) raises the general topic of lexical ambiguity: a word can have different meanings in different syntactic classes or in the same syntactic class. In isolation, the word "total" could be either a verb or a noun. In Query 124, "total" is used as a verb and has two possible meanings as a verb in this query: "add up" or "destroy." Exemplar I.B.1. (#16) discusses how disambiguation can be accomplished by considering the normal goals of actors. This method of disambiguation does not work for Query 124 however. Both meanings of "total" are conceivably valid in the context of the goals of military actors so additional context would have to be accessed in order to resolve this ambiguity.

Natural Language Sourcebook I.C.1.:
Single-Utterance Issues,
Modifier Attachment, Prepositional Phrase.

Query 127: Show me the number of submarines with readiness C4

In Query 127, the prepositional phrase "with readiness C4" could modify the verb or any of the noun phrases in this query. For example, Query 127 could be paraphrased in either of the following ways: 1) Show me, with readiness C3, the number of submarines, or 2) Show me the number of submarines that have readiness C3. The problem of prepositional phrase attachment is presented generally in Exemplar I.C.1. (#3). Potential readings of the IRUS queries could be eliminated on the basis of semantic world knowledge: for example, perhaps readiness C3 is a property of submarines, not people. Exemplar I.C.1. (#6) discusses how proper attachments can be determined on semantic grounds.

Query 70: Display the position of Kirk

Query 70 contains an "of" prepositional phrase, "of Kirk," which modifies the noun "position." Exemplars I.C.1. (#8) and (#9) discuss the attachment of "of" phrases such as "of Kirk." The noun "position" expects an "of" phrase to follow (position of what?), but not all nouns do as is discussed in Exemplar I.C.1. (#9).

Natural Language Sourcebook I.C.2.:
Single-Utterance Issues, Modifier Attachment, Other.

Query 109: Are there ships in the Indian Ocean that are C4
Query 17: What ships that are C4 are deployed in the Indian Ocean

Query 109 contains a relative clause, "that are C4." Exemplar I.C.2. (#1) considers three problems in handling relative clauses as postnominal modifiers. The first of these problems, finding the concept that the clause is modifying, could be relevant to query 109 if subject-verb agreement and semantics are not considered: in this case the relative clause "that are C4" could modify either of the nouns "ships" or "Indian Ocean." The second topic of Exemplar I.C.2. (#1), organizing the processing of the modifier, applies to query 109 in that the relative clause "that are C4" and the sentence "The ships are C4" should be handled in the same way. The third issue, that of determining where the modifying construction ends and the higher level construction continues, can be illustrated by comparing query 109 with Query 17. In Query 17, "are deployed in the Indian Ocean" is a continuation of the higher level construction, whereas, in Query 109, the sentence ends after the relative clause so there is no return to the higher level construction.

Natural Language Sourcebook I.D.4.:
Single-Utterance Issues, Temporal Reference.

Query 19: Did the Frederick deploy yesterday
Query 155: When will Vinson upgrade

IRUS Query 19 contains the temporal referent "yesterday." Exemplar I.D.4. (#1) discusses how understanding of temporal referents involves manipulation of relative time intervals. To understand the referent of "yesterday," the system must know when

the query was uttered and then determine the referent of "yesterday" relative to this time. Query 155 and others containing the question word "when" (see appendix), demand responses that could require an understanding of relative time as well.

Natural Language Sourcebook I.F.: Single-Utterance Issues, Other.

Query 156: What AAW rating is forecasted for Vinson

The IRUS queries include passive clauses such as Query 156. Passive clauses present different patterns of semantic roles than do active clauses. The processing of syntax and semantics in passive clauses is discussed in Exemplar I.F. (#2).

Query 42: List ships which are in the Indian Ocean and which are TLAM capable

In processing Query 42, a parser needs to determine what the conjunction "and" conjoins and what words, if any, are missing through ellipsis. These two tasks are related: if "and" conjoins two sentences, the missing words complete these sentences, that is, "List ships which are in the Indian Ocean and [list ships] which are TLAM capable; if "and" conjoins two modifying relative clauses, no words are missing and the sense of Query 42 is to list those ships which are both in the Indian Ocean and TLAM capable. Exemplars I.F. (#8) and (#10) discuss the issues of coordination and ellipsis, but neither addresses the ambiguity which can result from ellipsis. Query 42 thus suggests an exemplar which would consider such ambiguity.

Query 10: List the PACFLT ships that are C4 or that are C5

Query 10 illustrates the problem of ambiguity resulting from ellipsis in a sentence containing the disjunction "or." This ambiguity is structurally similar to that in Query 42 which contains "and" rather than "or." The Sourcebook does not contain any examples with the coordinator "or" although it does address joining by "and" [Exemplars I.F. (#8) and (#10)]. Query 10 and others (see Appendix B) thus suggest an exemplar discussing coordination using "or" and ambiguity resulting from coordination and ellipsis (as in Query 42).

Query 9: What's Hammond's readiness
Query 47: Who is the commanding officer of Vinson

Many Wh-questions such as Query 9 and Query 47 are included in the IRUS queries. There is no Sourcebook exemplar which discusses the processing of Wh-questions.

Wh-questions correspond structurally to statements, and the processing of a Wh-question should be similar to the processing of the corresponding statement form. For example, Query 9, "What's Hammond's readiness," is structurally similar to the statement "Hammmond's readiness is C2," and the processing of question and statement should be similar.

Natural Language Sourcebook II.

The Irus queries are presented as single utterances, but when utterances are used in sequence and reference to previous utterances is necessary for understanding, connected-utterance issues become relevant. As described in the Sourcebook, a natural language understanding system need not access any model of the user in understanding connected-utterance issues.

The pairs of utterances considered in the following discussions are not necessarily sequentially presented in the

source data (query numbers from Appendix A). For the purposes of the following discussions, it is assumed that the paired queries are adjacent and sequential in time.

Natural Language Sourcebook II.A.: Connected-Utterance Issues, Anaphora.

Query 162: For what reason did Frederick downgrade
Query 163: When will it change

Queries 162 and 163 form a discourse which includes the anaphor "it" in Query 163. The word "it" has as its antecedent a state which is not explicitly mentioned in the text. The state to which "it" refers, Frederick's degraded status of C3, must be inferred. Exemplars II. A. (#4) and (#12) discuss discourse in which antecedents must be similarly inferred.

Query 7: Display the Reeves, Sterett, Towers, Knox, Cochrane, Oldendorf, Lockwood, and Kirk
Query 134: Which of them are C3

Queries 7 and 134 form a discourse which includes the anaphor "them" in Query 134. The third person plural pronoun "them" does not have an explicit antecedent in Query 7; all possible antecedents in Query 7 are third person singular. An understander must realize that the singular ships in Query 7 can be combined in a set and referred to in the plural. Inference of a set as an antecedent for an anaphor is discussed in Exemplar II. A. (#15).

Query 153: What is the projected readiness of Vinson
Query 159: What is the reason for the degradation

Queries 153 and 159 form a discourse in which the antecedent of "the degradation" must be inferred. This is a complex inference involving the recognition that the projected readiness of Vinson is a state, comparison of two states in time, and the calculation that the change of state in time is negative. Exemplars II. A. (#15), (#16), and (#18) all discuss inference of antecedents which are not explicitly mentioned, but the inference in Queries 153 and 159 requires reasoning more complex than in these exemplars.

Query 69: Where are they now

The IRUS queries include many instances of anaphoric reference, some of which are noted above. Simple anaphoric reference of pronouns as in Query 69 (the pronoun "they") is common. The exemplars involving anaphora in the Sourcebook do not discuss such simple anaphoric reference; they are concerned with more indirect and complex uses of anaphora such as those discussed in the preceding paragraphs.

Natural Language Sourcebook II.B.: Connected-Utterance Issues, Ellipsis.

Query 148: Which ships have degraded to C3
Query 149: C4

Queries 148 and 149 must be understood as a pair. Query 149, "C4," is not by itself a grammatical utterance: it is an elliptical phrase understood by analogy with query 148. Exemplars II.B. (#1) and (#5) discuss similar pairs of utterances.

Natural Language Sourcebook III.

True-dialogue issues in the Sourcebook require that the natural language understanding system "know not only about the sequence of utterances read, but also something about the user's goals, intents, and expectations. . . . With true-dialogue issues, the system does not simply give responses to the user's input, but brings to bear knowledge about users and their use of language in deciding on the response" (Read et al., 1990). If the system is intended to operate as a knowledgeable entity, true-dialogue issues must be addressed.

Natural Language Sourcebook III.B.:
True-Dialogue Issues, Logical Presupposition.

Query 18: What ships deployed to the IO are C4

Query 18 presupposes that there exist ships deployed to the Indian Ocean. In order to answer Query 18, the system must be able not only to process the input utterance, but it must also know what the user's expectations in asking the question are. If there are no ships deployed to the Indian Ocean, it is more appropriate for the system to respond "There are no ships deployed to the IO" than to respond "None" to the query "What ships deployed to the IO are C4." Relevant discussions of logical presupposition are given in Exemplars III.B. (#1) and (#3).

Natural Language Sourcebook IV.

The Sourcebook divides ill-formed input (Group IV of exemplars) into two broad categories: "input which the user will see as ill-formed (e.g., typing mistakes), and input which the user expects the system to handle but which is nonstandard in some way" (Read et al., 1990). The IRUS queries present processing problems in both of these categories.

Natural Language Sourcebook IV.A.1.:
Ill-Formed Input, Mistakes--Mistypings.

Query 36: What vessels in th Indian Ocean have harpoon

Query 36 contains a misspelled word. The problem of misspelling is addressed in Exemplar IV.A.1. (#1). In attempting to match a misspelled word to a set of possible corrections, the parser must consider syntactic and semantic constraints on each possible correction.

Natural Language Sourcebook IV.B.1.:
Ill-Formed Input, Non-Standard Input--Incomplete Sentence.

Query 64: Diego Garcia

In isolation, Query 64 can be interpreted as an incomplete sentence. Exemplar IV.B.1. (#2) discusses a similar but not totally parallel example of sentence fragment. The example in Exemplar IV.B.1. (#2) clearly contains a complete thought to a native English speaker. Fragments such as Query 64 could conceivably contain a complete thought to a system user who routinely uses shorthand expressions.

If Query 64 occurred in context, perhaps it could be understood as an instance of ellipsis [Exemplars II.B. (#1) and (#5), and, for example, IRUS Queries 148 and 149].

Summary

From this consideration of the IRUS queries in relation to the Natural Language Sourcebook, it appears that the coverage of processing problems presented in the Sourcebook is sufficiently comprehensive to be of practical use. Processing concerns in 137 of the 163 IRUS queries relate to issues discussed in the Sourcebook. The remaining 26 queries (marked by an asterisk in Appendix B) fall into three groups: six are Wh-questions similar to queries 9 and 47 discussed on page 11*, six include simple anaphoric reference as discussed on page 13*, and fourteen are not discussed in this paper. These fourteen queries (listed in Appendix B) are mainly simple imperatives, e.g., Query 1, "Display PACOM," and simple subject/auxiliary inversion questions, e.g., Query 61, "Is the Kennedy in port."

*Many of the queries present multiple processing problems and so are listed in more than one group in Appendix B. For example, Query 77 appears in the first three groups. Some groups, for example the group concerned with logical presupposition [Exemplars III.B.(#1) and (#3)] and represented by Query 18, are not listed in full because these groups contain a very large number of queries.

Multiple listings of queries means that a query in a group not covered by a Sourcebook exemplar may present other processing problems that are covered in the Sourcebook. For example, Query 4, which appears in a group with no relevant exemplar (page 25), also appears in a group relevant to Exemplars I.C.1. (#8) and (#9) (page 23).

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Appendix A

Below is the list of queries from the August 1986 CINCPACFLT demonstration which served as the source of information for the linguistic capabilities of IRUS.

IRUS QUERIES

1. "Display PACOM"
2. "Display all carriers"
3. "Summarize the Midway's ratings"
4. "What is the readiness of the ships in Midway's battle group"
5. "Which are LAMPS capable"
6. "Which are harpoon capable?"
7. "Display the Reeves, Sterett, Towers, Knox, Cochrane, Oldendorf, Lockwood and Kirk?"
8. "Where is the Francis Hammond"
9. "What's Hammond's readiness"
10. "List the PACFLT ships that are C4 or that are C5"
11. "Display the PACOM area"
12. "Display all carriers in PACFLT"
13. "When was the last update to Midway's readiness?"
14. "Display positions of all carriers in PACFLT"
15. "List the ships that are c4 or that are c5"
16. "List the ships in PACFLT that are c4 or that are c5"
17. "Which ships that are C4 are deployed in the Indian Ocean"
18. "What ships deployed to the IO are C4"
19. "Did the Frederick deploy yesterday"
20. "List the ships deployed in the Indian Ocean"
21. "What ships are deployed to the Indian Ocean"
22. "Where is the Carl Vinson deployed"
23. "Is the Frederick deployed in the Indian Ocean"
24. "List the number of ships that ARE deployed in INDIAN OCEAN"
25. "List the ships deployed in the Indian Ocean"
26. "What is the total number of destroyers in PACFLT"
27. "How many cruisers are in EASTPAC"
28. "Count the frigates in WESTPAC"
29. "List the battleships in MIDPAC"
30. "What is the total number of cruisers in INDIAN OCEAN"
31. "What ships in WESTPAC are LINK-11 capable"
32. "How many subs in IO have SAR capability"
33. "What ships are SAR capable"
34. "List THE harpoon capable ships in EASTPAC"
35. "Does Frederick have TACAN"
36. "What vessels in th INDIAN OCEAN have harpoon"
37. "How many ships that are harpoon capable are there in the Pacific Fleet"
38. "How many harpoon capable ships are in PACFLT"
39. "What ships in San Diego are harpoon capable"
40. "What deployed ships are harpoon capable"
41. "What deployed ships in the Indian Ocean are harpoon capable"

42. "List ships which are in the Indian Ocean and which are TLAM capable"
43. "What ships are TASM capable"
44. "How many harpoon capable ships are there in INDIAN OCEAN?"
45. "What's the name of the commander of Frederick"
46. "Who is the CO of Frederick"
47. "Who is the commanding officer of Vinson"
48. "What Battle Group is Leahy in"
49. "What are the hull numbers of the ships with NTDS"
50. "What is the Vinson's present speed"
51. "What is Vinson's current course"
52. "What's Vinson's speed"
53. "What is the speed of Frederick"
54. "What operational area is the C4 submarine in"
55. "Which are in SD"
56. "How many US ships are in the INDIAN OCEAN"
57. "List the US Ships"
58. "Are there any submarines in the South China Sea"
59. "What port is that ship in"
60. "What port is that track in"
61. "Is the Kennedy in port"
62. "List the ships in San Diego"
63. "List the ships that are in San Diego"
64. "Diego Garcia"
65. "How many ships are in San Diego"
66. "Which port is Vinson in"
67. "Is Vinson in San Diego"
68. "What is its position"
69. "Where are they now"
70. "Display the position of Kirk"
71. "Where is the Carl Vinson"
72. "Which ships that are C5 are in SD?"
73. "What is the overall readiness of Frederick"
74. "What is Frederick's readiness today"
75. "What is the CROVL of Frederick"
76. "What is Frederick's combat rating"
77. "What is the personnel resource rating on Vinson"
78. "What is its supplies resource readiness"
79. "Which ships in WESTPAC have an equipment resource readiness of C3"
80. "List the ships in the INDIAN OCEAN with a training resource rating of C2"
81. "What is her AMW rating"
82. "CROVL Kennedy"
83. "CROVL of Kennedy"
84. "Find the overall readiness of John F. Kennedy"
85. "What is Frederick's current readiness"
86. "What is Frederick's personnel readiness"
87. "Does Frederick have a personnel resource readiness of C3"
88. "Show the current overall readiness of Vinson"
89. "What is the present AAW mission readiness of Vinson"
90. "What is the ASW readiness of Vinson right now"
91. "Show the ASU rating code of Vinson"
92. "C3 ships"

93. "What is Frederick's CCC readiness"
94. "Is Frederick C4"
95. "What is her readiness"
96. "Is Frederick M4 in LOG"
97. "What is the overall readiness of JL Brown?"
98. "What is the equipment resource rating on it"
99. "What is its supplies resource readiness?"
100. "Show the MOB rating code of JL Brown"
101. "What is its readiness today?"
102. "What is Gallery's combat rating?"
103. "What is Gallery's MOB rating?"
104. "What is CALIFORNIA's current readiness?"
105. "Does INGERSOLL have an INT readiness of M4?"
106. "How many C-4 ships are there"
107. "How many C-5 ships"
108. "Are there any C4 ships in the Indian Ocean"
109. "Are there ships in the Indian Ocean that are C4"
110. "What ships are C-5 today"
111. "What are the C4 ships"
112. "How many ships are C-5"
113. "How many of the ships in INDIAN OCEAN are C-5"
114. "How many are C4"
115. "Which ships are C4"
116. "What is the total number of EASTPAC ships that are C4"
117. "Which ships have a C4 personnel resource rating"
118. "How many deployed carriers are C3"
119. "What ships are reporting C3"
120. "List the ships that are reporting C3"
121. "Ships whose overall readiness is C3"
122. "C3 ships"
123. "Count the submarines that are C3"
124. "Total the C3 submarines"
125. "Which submarines have a readiness that is C3"
126. "What submarines have a C3 readiness rating"
127. "Show me the number of submarines with readiness C3"
128. "List the subs whose readiness is C3"
129. "List the ships in the INDIAN OCEAN with a training resource rating of C4"
130. "How many cruisers are deployed that are C3"
131. "How many cruisers that are deployed are C3"
132. "Which are C3"
133. "List those ships"
134. "Which of them are C3"
135. "List the C3 ships"
136. "How many of them are C3"
137. "Which of these ships are C2"
138. "Which ships that are C4 are deployed in the Indian Ocean"
139. "What are the C4 deployed ships in the INDIAN OCEAN"
140. "Which ships that are C4 are in San Diego"
141. "How many ships in the INDIAN OCEAN are C-3"
142. "List the ships that are C4"
143. "Which ships in WESTPAC are C3?'
144. "Which submarines in WESTPAC have an equipment resource readiness of C3?"

145. "List the ships whose overall readiness is C3"
146. "How many ships in the Third Fleet are C-3"
147. "When was Frederick's readiness downgraded"
148. "Which ships have degraded to C3"
149. "C4" ,
150. "What was their previous overall readiness"
151. "What ships reported C3"
152. "Did Frederick report a C3 readiness"
153. "What is the projected readiness of Vinson"
154. "What overall readiness rating is forecasted for Vinson"
155. "When will Vinson upgrade"
156. "What AAW rating is forecasted for Vinson"
157. "What ASU rating is expected for Vinson"
158. "Does Frederick expect a C2 readiness"
159. "What is the reason for the degradation"
160. "Why did Frederick downgrade to C3"
161. "Why did Frederick downgrade"
162. "For what reason did Frederick downgrade to C3"
163. "When will it change"

Appendix B

IRUS Queries Organized by Relevant Exemplars

(Queries with an underlined query number are directly addressed in discussion. Queries marked by an asterisk do not present processing problems covered in the Sourcebook).

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40. What deployed ships are harpoon capable.
41. What deployed ships in the Indian Ocean are harpoon capable.
77. What is the personnel resource rating on Vinson.
80. List the ships in the INDIAN OCEAN with a training resource rating of C2.
98. What is the equipment resource rating on it.
102. What is Gallery's combat rating.
103. What is Gallery's MOB rating.
117. Which ships have a C4 personnel resource rating.
118. How many deployed/carriers/are C3.
129. List the ships in the INDIAN OCEAN with a training resource rating of C4.

Exemplar I. A. (#1)

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77. What is the personnel resource rating on Vinson.
78. What is its supplies resource readiness.
(Query 78 also appears as query 99 in Appendix A)
89. What is the present AAW mission readiness of Vinson.
100. Show the MOB rating code of JL Brown.
154. What overall readiness rating is forecasted for Vinson.

Exemplars I. A. (#2) and I. A. (#7).

---

77. What is the personnel resource rating on Vinson.
98. What is the equipment resource rating on it.
102. What is Gallery's combat rating.
103. What is Gallery's MOB rating.

Exemplar I. B. 1. (#22) is close but better to add an exemplar specific to ambiguity involving the present participle.

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18. What ships deployed to the IO are C4.

Exemplar I. A. (#3)

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32. How many subs in IO have SAR capability.
35. Does Frederick have TACAN.
36. What vessels in th INDIAN OCEAN have harpoon.
79. Which ships in WESTPAC have an equipment resource readiness of C3.
87. Does Frederick have a personnel resource readiness of C3.
105. Does INGERSOLL have an INT readiness of M4.
117. Which ships have a C4 personnel resource rating.
125. Which submarines have a readiness that is C3.
126. What submarines have a C3 readiness rating.
144. Which submarines in WESTPAC have an equipment resource readiness of C3.

Exemplar I. B. 1. (#2).

---

124. Total the C3 submarines.

Exemplars I. B. 1. (#16) and (#19).

---

127. Show me the number of submarines with readiness C3.
12. Display all carriers in PACFLT.
14. Display positions of all carriers in PACFLT.
28. Count the frigates in WESTPAC.
29. List the battleships in MIDPAC.
34. List the harpoon capable ships in EASTPAC.
62. List the ships in San Diego.
80. List the ships in the INDIAN OCEAN with a training resource rating of C2.
129. List the ships in the INDIAN OCEAN with a training resource rating of C4.

Exemplars I. C. 1. (#3) and (#6).

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70. Display the position of Kirk.
4. What is the readiness of the ships in Midway's battle group.
14. Display positions of all carriers in PACFLT.
24. List the number of ships that are deployed in Indian Ocean.
26. What is the total number of destroyers in PACFLT.
30. What is the total number of cruisers in INDIAN OCEAN.
47. Who is the commanding officer of Vinson.
49. What are the hull numbers of the ships with NTDS.
84. Find the overall readiness of John F. Kennedy.
88. Show the current overall readiness of Vinson.
91. Show the ASU rating code of Vinson.
100. Show the MOB rating code of JL Brown.
etc.

Exemplars I. C. 1. (#8) and (#9)

---

109. Are there ships in the Indian Ocean that are C4.
17. Which ships that are C4 are deployed in the Indian Ocean.
(Query 17 also appears as query 138 in Appendix A)
18. What ships deployed to the IO are C4.
37. How many ships that are harpoon capable are there in the Pacific Fleet.
72. Which ships that are C5 are in SD.
131. How many cruisers that are deployed are C3.
140. Which ships that are C4 are in San Diego.

Exemplar I. C. 2. (#1)

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19. Did the Frederick deploy yesterday.
155. When will Vinson upgrade.
13. When was the last update to Midway's readiness.
69. Where are they now.
101. What is its readiness today.
147. When was Frederick's readiness downgraded.
163. When will it change.

Exemplar I. D. 4. (#1).

---

156. What AAW rating is forecasted for Vinson.
154. What overall readiness rating is forecasted for Vinson.
157. What ASU rating is expected for Vinson.

Exemplar I. F. (#2).

---

42. List ships which are in the Indian Ocean and which are TLAM capable.

Exemplars I. F. (#8) and (#10). Suggests another exemplar which addresses the ambiguity in 42.

10. List the PACFLT ships that are C4 or that are C5.
15. List the ships that are C4 or that are C5.
16. List the ships in PACFLT that are C4 or that are C5.

Similar to Exemplars I. F. (#8) and (#10) but have "or" rather than "and". Suggests exemplar with "or."

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* 9. What's Hammond's readiness.
47. Who is the commanding officer of Vinson.
4. What is the readiness of the ships in Midway's battle group.
* 5. Which are LAMPS capable.
* 6. Which are harpoon capable.
* 8. Where is the Francis Hammond.
* 21. What ships are deployed to the Indian Ocean.
* 22. Where is the Carl Vinson deployed.
etc.

No relevant exemplar.

---

162. For what reason did Frederick downgrade to C3.
163. When will it change.

Exemplars II. A. (#4) and (#12).

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7. Display the Reeves, Sterett, Towers, Knox, Cochrane, Oldendorf, Lockwood and Kirk.
134. Which of them are C3.

Exemplar II. A. (#15)

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153. What is the projected readiness of Vinson.
159. What is the reason for the degradation.

Similar to II. A. (#15), (#16) and (#18) but more complicated inference.

Simple Anaphoric Reference:

69. Where are they now.
* 68. What is its position.
78. What is its supplies resource readiness.
(Query 78 also appears as query 99 in Appendix A)
* 81. What is her AMW rating.
* 95. What is her readiness.
98. What is the equipment resource rating on it.
101. What is its readiness today.
*134. Which of them are C3.
*136. How many of them are C3.
*150. What was their previous overall readiness.

No relevant exemplar.

---

148. Which ships have degraded to C3.
149. C4.
106. How many C4 ships are there.
107. How many C5 ships.

Exemplars II. B. (#1) and (#5)

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18. What ships deployed to the IO are C4.
20. List the ships deployed in the Indian Ocean.
    (Query 20 also appears as query 25 in Appendix A)
36. What vessels in th Indian Ocean have harpoon.
38. How many harpoon capable ships are in PACFLT.
39. What ships in San Diego are harpoon capable.
etc.

Exemplars III. B. (#1) and (#3).

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36. What vessels in th Indian Ocean have harpoon.

Exemplar IV. A. 1. (#1)

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64. Diego Garcia.
82. CROVL Kennedy.
83. CROVL of Kennedy.
92. C3 ships.
121. Ships whose overall readiness is C3.
122. C3 ships.

Exemplar IV. B. 1. (#2)

Queries not discussed:

* 1. Display PACOM.
* 2. Display all carriers.
* 3. Summarize the Midway's ratings.
* 11. Display the PACOM area.
* 57. List the US ships.
* 61. Is the Kennedy in port.
* 67. Is Vinson in San Diego.
* 94. Is Frederick C4.
*133. List those ships.
*152. Did Frederick report a C3 readiness.
*158. Does Frederick expect a C2 readiness.
*160. Why did Frederick downgrade to C3.
*161. Why did Frederick downgrade.
*162. For what reason did Frederick downgrade to C3.